

http://www-sn.jsc.nasa.gov/astrobiology/biomarkers/index.html

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purpose

Through research on ancient Earth rocks, modern hot springs, and Mars meteorites, the Institute is dedicated to identifying specific properties of a rock, soil, or other samples which indicate that biological activity is occurring or has occurred.

Institute for the Study of Biomarkers in Astromaterials

NASA Johnson Space Center and 13 Co-Investigator Programs

Dr. David S. McKay,

Principal Investigator

JSC Institute Team Research members:

Dr. Everett Gibson Kathie Thomas-Keprta Susan Wentworth Dr. Carlton Allen Dr. Frances Westall Mary Sue Bell Dr. Andrew Steele

E/PO members:

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research highlights

search for evidence of biomarkers in meteorites from mars

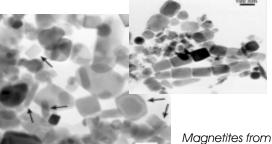
The team demonstrated that a significant percentage of magnetite crystals in ALH84001 are structurally and chemically identical to magnetites produced only by bacteria.



The bacteria-like forms in Nakhla are the focus of intense research.

Initial research produced intriguing indications of possible microfossils in two additional martian meteorites, Nakhla and Shergotty.

Laboratory experiments reproduced key crystallographic and textural features of martian meteorites to assess the interdependence of these features with microorganisms.

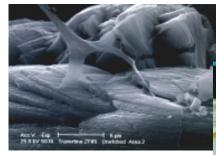


The team also established that gamma radiation can effectively sterilize returned Mars samples without altering their isotopic signatures, elemental compositions, or crystal structures.

Magnetites from ALH84001 show striking similarities to biogenic magnetites on Earth.

documentation of terrestrial biomarkers

A published paper documented the fossilization of bacteria, cell fragments, and biofilms in deep subsurface basalt flows. Additional research has proved that biofilms on rock surfaces are rapidly mineralized and can be preserved for billions of years. We are completing a study to document physical biomarkers which reveal evidence of life in carbonate hot springs.



Biofilms are ubiquitous and easily fossilized biomarker.

Primitive thermophiles from hot springs are yielding important data about life in extreme environments.

We initiated the first dedicated Astrobiology session at the Lunar and Planetary Science Conference, with presentations by eight of our Co-I programs.

co-investigator research

Dr. Dennis Bazylilnski

Iowa State University

- Grow bacteria which synthesize nanometer-scale iron oxides
- Document features in iron oxides unique to a bacterial origin

Dr. Henry Chafetz

University of Houston

- Document biomarkers in silica and carbonate hot spring deposits
- Document biomarkers in carbonate mud deposits

Dr. George Flynn

State University of New York, Plattsburgh

 Study the organic component associated with mineral biomarkers in martian meteorite ALH84001 using advanced x-ray and infrared analytical techniques

Dr. Larry Hersman

Los Alamos National Laboratory

- Study fossilized macromolecules on mineral surfaces using atomic force microscopy
- Investigate sensitive and site specific fluorescence staining for DNA, proteins and lipids

Dr. Nancy Hinman University of Montana

- Determine temperature of formation of minerals using nuclear magnetic resonance techniques
- Investigate the interaction of iron and oxygen in the presence of microbial surfaces

Dr. Richard Hoover

Marshall Spaceflight Center

- Investigate morphological biomarkers in ancient rocks and deep ice
- · Coordinate collaboration with Russian colleagues

Dr. Thomas Kieft

New Mexico Tech

 Investigate biomarkers in extreme terrestrial environments, including acid hot springs and deep mines

Dr. Penny Morris

University of Houston — Downtown

 Document morphological and chemical evidence for life in the oldest Earth rocks

Dr. James Papike

University of New Mexico

 Document hydrogen, carbon, sulfur and nitrogen isotope fractionation associated with life in terrestrial rocks

Dr. Lisa Robbins

Florida State University

 Produce minerals similar to those found in ALH84001 in a Mars-like environment using sulfate reducing bacteria

Dr. Chris Romanek

University of Georgia

 Document features of iron carbonate minerals unique to a bacterial origin

Dr. Allan Treiman

Lunar and Planetary Institute

 Characterize differences between biogenic and non-biogenic oxide, sulfate, carbonate and phosphate minerals

Dr. Norman Wainwright

Marine Biological Laboratory

 Develop tracer techniques for detecting individual cells or cell components in geologic materials